

Predictors of Weapon Carrying in Youth Attending Drop-in Centers

Elaine J. Blumberg, MA; Sandy Liles, MPH; Norma J. Kelley, BS;
Melbourne F. Hovell, PhD, MPH; Chad A. Bousman, MPH;
Audrey M. Shillington, PhD; Ming Ji, PhD; John Clapp, PhD

Objective: To test and compare 2 predictive models of weapon carrying in youth (n=308) recruited from 4 drop-in centers in San Diego and Imperial counties. **Methods:** Both models were based on the Behavioral Ecological Model (BEM). **Results:** The first and second models significantly explained 39% and 53% of the variance in weapon carrying, respectively, and both full models shared the significant predictors

of being black(-), being Hispanic (-), peer modeling of weapon carrying/jail time(+), and school suspensions(+). **Conclusions:** Results suggest that the BEM offers a generalizable conceptual model that may inform prevention strategies for youth at greatest risk of weapon carrying.

Key words: weapon carrying, risk factors, protective factors, adolescents, drop-in centers

Am J Health Behav. 2009;33(6):745-758

Weapon carrying is a public health concern due to its association with violent/aggressive behaviors and negative health-related outcomes, including physical fighting,¹⁻³ bullying,⁴

aggressive behavior,⁵ weapon use,^{1,6} violence perpetration,^{7,8} injury,⁹ and severity of injury.⁶ Weapon carrying is also important because of its relationship with other problem behaviors, including drinking, smoking, and truancy,¹⁰ early sexual activity,¹¹ school and family problems,¹² and arrests.¹³

The prevalence of youth weapon carrying has been based on a variety of samples, settings, dates, and definitions, with rates ranging from 8.4% to 26.1%.^{11,14-19} Youth Risk Behavior Survey (YRBS) results reveal a declining rate of weapon carrying, from 26.1% in 1993 to 17.1% in 2003.²⁰ However, over the same period, students were increasingly likely to miss school due to concerns over their safety, and in 2003 almost 1 in 10 students reported threat or injury involving a weapon on school grounds during the prior 12 months.²⁰ In 2007, 18.0% of high school students had carried a weapon in the past 30 days, 7.8% were threatened or injured with a weapon on school property in the past 12 months, and 5.5% had not attended school in the past 30

Elaine J. Blumberg, Adjunct Assistant Professor; Sandy Liles, Research Associate; Norma J. Kelley, Research Associate; Melbourne F. Hovell, Distinguished Professor; Ming Ji, Associate Professor, all from the Center for Behavioral Epidemiology and Community Health, Graduate School of Public Health, San Diego State University, San Diego, CA. Chad A. Bousman, Doctoral Student, San Diego State University/University of California, San Diego, Joint Doctoral Program in Public Health (Health Behavior), La Jolla, CA. Audrey M. Shillington and John Clapp, Professors, School of Social Work, San Diego State University, San Diego, CA.

Address correspondence to Ms Blumberg, Center for Behavioral Epidemiology and Community Health, Graduate School of Public Health, San Diego State University, 9245 Sky Park Court, Suite 230, San Diego, CA 92123. E-mail: eblumberg@projects.sdsu.edu

days due to feeling unsafe.²¹ Concerns regarding weapon carrying prompted a Healthy People 2010 objective: to reduce weapon carrying on school property during the past 30 days by students in grades 9-12, from the 1999 baseline rate of 6.9%, to only 4.9%.²²

Studies have identified a number of risk factors for weapon carrying, including substance use,²³⁻²⁵ rural location,²⁶ perception that peers carried weapons,^{27,28} and neighborhood and other environmental characteristics.^{23,29-31} Perhaps the most frequently cited risk factor for weapon carrying is male gender.^{10,23,30} Some studies have explored separate predictive models for males and females.^{23,32}

A number of protective factors of weapon carrying have also been identified. These include time in religious activities and nonschool clubs,³³ social support,³⁴ living with both parents,³⁰ feeling of closeness to parents,¹² a positive relationship with parents,³⁵ parental monitoring,³⁵ and the lack of parental support for fighting.³⁵

Most predictive studies of youth weapon carrying are based on school samples and those using YRBS data are common. However, few studies have examined potential risk and protective factors of weapon carrying in youth from other venues. The current study was based on 14- to 24-year-old youth attending drop-in centers in San Diego and Imperial counties, and thus examines an older sample than most previous studies as well as weapon carrying not restricted to instances on school property.

The YRBS²¹ describes rates of weapon carrying in the city of San Diego for high school students; YRBS data are not provided for San Diego and Imperial counties. Weapon carrying rates (and 95% CIs) in San Diego city were female 6.2% (3.9-9.6), male 21.8% (18.5-25.5), total 14.1% (11.7-16.9), falling slightly below the median percentages for all 22 cities/counties included in the YRBS.²¹ Data regarding incidents on school property showed that 5.0% of San Diego students had carried a weapon and 8.1% had been threatened or injured with a weapon; both percentages were slightly lower than the median for all 22 cities/counties surveyed.²¹

The purpose of the present study was to test and compare 2 predictive models of weapon carrying. Examination of the replication model was designed as a test of the generalizability of a model previously used

to predict substance use.³⁶ The test of the expanded model was intended to explore the effects of adding more background variables as well as new conceptual domains to the replication model. The replication model included determinants representing the domains of demographics/background, parenting, peer influences, and school performance. The expanded model retained these potential influences and added variables representing the domains of risk behaviors, living situation, and neighborhood characteristics.

The factors examined in each of these models were selected based on the Behavioral Ecological Model (BEM).^{37,38} Previously applied to analyses of health risk behaviors,³⁹ tobacco use,^{40,41} and physical activity,⁴² the BEM stems from principles of classical conditioning, operant conditioning, and social learning theory.³⁷ It includes an emphasis on social contingencies of reinforcement, modeling, and imitation and their interactions as major influences on behavior. However, the BEM also extends to society-level contingencies that influence behavior directly or in an additive or synergistic fashion.

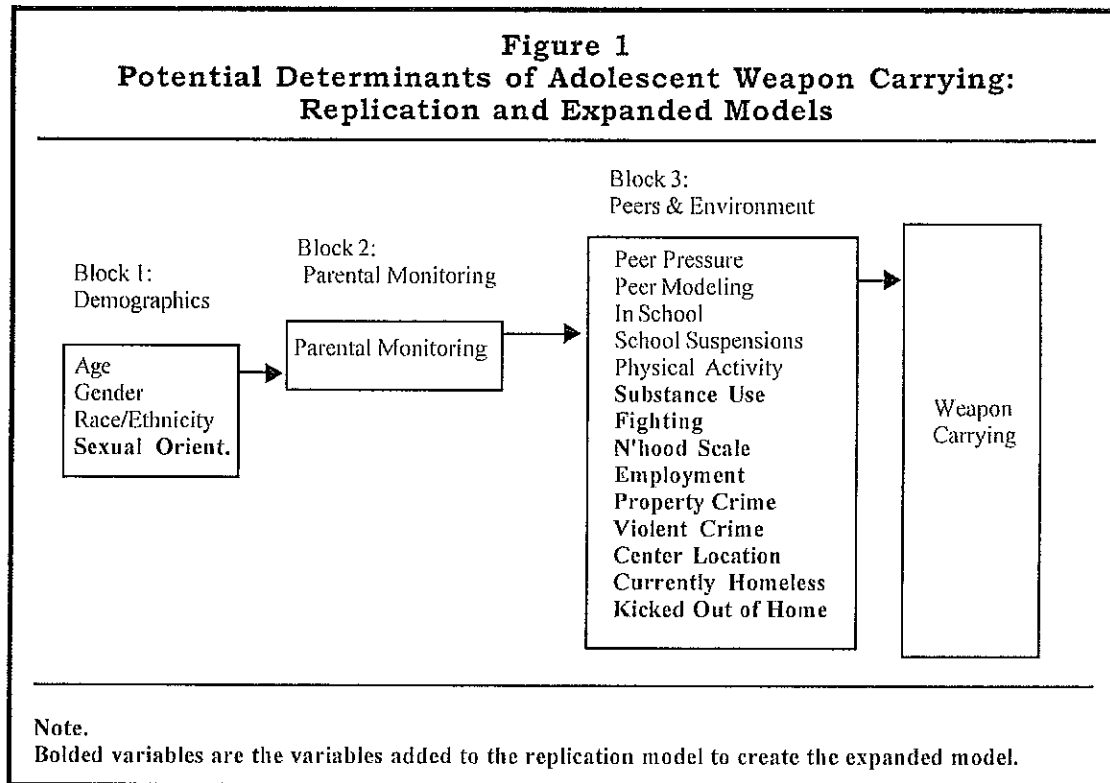
The BEM is a developing model that emphasizes the need to study the combined effects of societal-level contingencies and the most proximal contingencies that are presumed to be the most powerful influences for an individual's behavior. These influences operate in multiple ecological contexts such as neighborhood, peer group, and family "cultures." In applying the BEM to the present study, we hypothesized that at each relevant ecological level the prevalence/density of behavioral influences established a set of social models and contingencies for or against weapon carrying.

METHODS

Design

This study was part of a larger longitudinal evaluation of 4 youth drop-in centers. The San Diego State University Institutional Review Board approved all measures and procedures for this study. A certificate of confidentiality from the US Department of Health and Human Services (No. MH-00-177) was obtained to protect participants.

Drop-in centers are designed to be safe and easy-to-find facilities where youth can go to receive free information and services. Such centers typically offer a variety of services that may include independent



living skills training, individual/group counseling, school referrals, dropout prevention, referrals to health and social services, food, conflict management, and recreational activities. The 4 drop-in centers in this study offered all of these services and additionally focused on HIV risk reduction through education, condom distribution, and testing. Three served youth in urban areas and 1 served rural youth. The 3 urban drop-in centers respectively targeted homeless/runaway youth; youth identifying as gay, lesbian, bisexual, transgender, or questioning; and Hispanic youth. The rural drop-in center almost exclusively served Hispanic youth.

Baseline data from the 4 drop-in centers were used to test the replication and expanded models. In each, the same 3 blocks of variables (Demographics, Parental Monitoring, Peers and Environment) were added sequentially to the model based on conceptual proximity to weapon carrying, with the most proximal variables based on the BEM being added last (Figure 1). The replication model tested was previously used to predict substance use in the subsample of homeless youth³⁶ attending 2 of the drop-in cen-

ters included in this study.

Screening, Recruitment, and Informed Consent

Potential participants were referred by center staff and then approached by a trained research assistant. Only youth identified as new center attendees were approached and given a brief description of the study. The research assistant directed interested youth individually to a private office where the study was described in more detail.

A screening interview was administered to determine eligibility. Youth were eligible to participate if they were ages 14 to 24 (the age range of clients served by the drop-in centers) and had attended the drop-in center fewer than 3 times (as the focus of the evaluation study was on "new" clients). The screening and recruitment process took approximately 15 minutes and included explanation of the study and informed consent/assent.

For participants under 18, if parental consent was not waived, parental consent was obtained either via mail or by youth returning signed consents to research staff

at the drop-in centers. As part of the screening and recruitment process, youth were given a parental consent form to take home to their parent/guardian and informed that a parental consent form would also be mailed to the appropriate address. The name and address of their parent/guardian were obtained and a packet including a cover letter to the parent; 2 copies of the parental consent form (1 to be signed and returned; 1 for parent to keep); and a self-addressed, stamped envelope was mailed to parents. Parental consent was waived if the interviewer determined that obtaining such consent would put the youth at risk for verbal/physical abuse.

Participants

A total of 389 youth were recruited to the study. For the present analyses the consistent cohort of participants having data for all the variables in both models was used ($n=308$) to calculate all descriptive and inferential statistics. Almost 60% (59.4%) of the participants were male, the mean age was 17.17 years ($SD=2.29$), and the mean number of years of education completed was 10.00 ($SD=1.78$). The sample was 54.2% Hispanic, 20.1% white, 13.3% black, and 12.3% other. Over a third (38.6%) reported working to earn money for themselves. Approximately two-thirds (68.5%) reported currently living in San Diego; 27.6% in Imperial county; and 1.9% in Riverside, Los Angeles, and Orange counties combined. The remaining 1.9% (6/308) reported currently living outside of California (ie, in Oregon [$n=2$], Colorado [$n=1$], Washington [$n=1$], Georgia [$n=1$], or Minnesota [$n=1$]).

Procedures

Participants completed a 30-minute survey regarding HIV/STD-related risk behavior, drug use, violence, peers, family, sexual activity, and drop-in center service utilization using audio computer-assisted survey instrument (A-CASI) technology. A-CASI allows for collection of sensitive information without the direct participation of an interviewer.⁴³ The surveys were conducted on laptop computers, using headphones and a mouse, and Questionnaire Development System software, version 2.0. Range and validity checks were used.

A sheet was given to participants with definitions of terms used in the interview. A research assistant was always present to answer any questions and to assist with

difficulties using the A-CASI. To protect privacy this research assistant was stationed at a distance where it was not possible to see the computer screen. Upon completion of the interview, all participants received a \$15 gift certificate to a local music store. The data obtained from each interview were saved to a disk and later transferred to a central database.

Measures

The survey for the larger study was developed for the purpose of program evaluation of 4 youth drop-in centers. The primary target outcomes for that evaluation were service use, client satisfaction, and reduction of HIV-related risk behaviors. For the present study, available variables from the program evaluation database regarding demographics, parental monitoring, and peer/environmental influences were used to explore possible predictors of weapon carrying. Response formats for items included nominal response categories, Y/N, raw numbers, or 3-point ordinal scales with explicit anchors.

A number of variables from the survey, including the dependent variable, were skewed in their original format; and for all of these cases, square root, logarithmic, and/or cube root transformations were attempted in order to reduce skewness. However, none of these variables were repairable by transformation, and they were therefore dichotomized. Continuous variables were dichotomized only in instances in which skewed distributions could not be corrected through transformation.

Dependent variable: weapon carrying.

Participants were asked, "During the past 3 months, on how many days did you carry a weapon such as a gun, knife, or club?" A dichotomous variable (yes=1-90 days, no=0 days) was created that served as the primary dependent variable for regression analyses.

Independent variables. Demographic variables included age, gender, race/ethnicity, and sexual orientation. Parental monitoring was assessed by 1 question using a 3-point ordinal scale (never through always): "How often do your parents, step-parents, or other guardians know where you are, who you are with, and what you are doing?" The peer and environmental variables were either scales or individual items. Four scales were created to represent peer pressure to drink alcohol and/or use other drugs, peer modeling of weapon

carrying and/or jail time, overall substance use, and perception of neighborhood crime/violence.

The peer-pressure scale was created using 2 Y/N items: "In the last 3 months, has a friend tried to get you to drink alcohol when you did not want to?" and "In the last 3 months, has a friend tried to get you to use drugs when you did not want to?" This scale (Cronbach's $\alpha=0.57$) ranged from 0 to 2 with high scores indicating more peer pressure to use alcohol/other drugs. This variable was dichotomized.

The peer-modeling scale contained 2 Y/N items assessing peers' jail time and weapon-carrying behavior: "In the last 3 months, have any of your close friends carried any type of weapon?" and "In the last 3 months, have any of your close friends spent time in a correctional facility such as a juvenile hall or jail?" This scale ($\alpha=0.58$) ranged from 0 to 2 with high scores indicating more peer modeling. The substance-use scale ($\alpha=0.65$) represented use of 6 substances (tobacco, alcohol, marijuana, methamphetamine, ecstasy, and inhalants) during the past 3 months. Overall drug scores ranged from 0 to 5 with higher scores indicating more drugs used.

The scale measuring youth's perceptions regarding crime and gangs in their neighborhood was created using two 3-point ordinal (1=not a problem, 2=some-what of a problem, 3=big problem) questions: "In your neighborhood for the last 3 months, how much of a problem is crime and violence?" and "In your neighborhood for the last 3 months, how much of a problem are gangs?" This scale ($\alpha=0.82$) ranged from 2 to 6 with high scores indicating a greater perception of crime, violence, and/or gangs.

The remaining independent variables were individual items assessing school status, history of school suspensions, vigorous exercise, physical fighting, employment, location of drop-in center where recruited (urban vs rural), current homelessness, number of times "kicked out of your house or the place you were living," and neighborhood property and violent crime rates.

A Y/N school status measure asked, "Are you currently in school?" School suspensions were assessed by the question "How many times in your life have you ever been suspended from school?" This variable was dichotomized.

Frequency of vigorous exercise was as-

sessed by asking, "During the past 3 months, how many times per week did you do vigorous activities for at least 10 minutes that caused heavy sweating or large increases in breathing or heart rate?" The range for this variable was 0-7 with higher values indicating greater amounts of exercise.

To assess fighting, participants were asked, "During the past 3 months, how many times were you in a physical fight?" This variable was dichotomized (yes=1-50, no=0). Employment was assessed by the Y/N question "Do you work to earn money for yourself?" Current homelessness was assessed by creating a dichotomous variable from the question "What is your current living situation?" A participant was coded as homeless if he or she reported living on the street, in a car, on the beach, in a shelter or mission, or in a squat or abandoned building. A variable assessing number of times kicked out of living quarters during the past 3 months was dichotomized.

Two variables were created to assess neighborhood property and violent crime rates, using data obtained from California's Criminal Justice Profiles⁴⁴ and the California Department of Finance.⁴⁵ Zip codes of participants' neighborhoods were linked to cities for the years corresponding to dates of interviews. Property crime rates were created by totaling the number of burglaries, motor vehicle thefts, and larceny thefts divided by each city's population. Violent crime rates were created by totaling the number of homicides, forcible rapes, robberies, and aggravated assaults divided by each city's population.

Statistical Analyses

All analyses were conducted using SPSS version 14.02. Descriptive statistics were used to examine the dependent and independent variables in the models. Sequential logistic regressions were used to determine predictors of weapon carrying in the past 3 months. Collinearity diagnostics were conducted for both models and found to be acceptable. Chi-squares were conducted to test for differences between the consistent cohort and the remainder of the sample.

RESULTS

Patterns of Weapon Carrying

Fifty-three participants (17.2%) reported carrying a weapon during the past

Table 1
Weapons Carried During the Past 3 Months (n=53)

Number of Weapons (% , n)	Types/Combinations of Weapons Carried	% (n)
1 (61.5%, 32)	Knife ^a	68.8% (22)
	Gun	6.3% (2)
	Pipe ^b	3.1% (1)
	Martial arts weapon	3.1% (1)
	Brass knuckles	3.1% (1)
	Pepper spray ^c	3.1% (1)
	Other weapon	12.5% (4)
2 (17.3%, 9)	Knife, stick	55.6% (5)
	Knife, gun	11.1% (1)
	Knife, martial arts weapon	11.1% (1)
	Knife, pepper spray	11.1% (1)
	Pipe, brass knuckles	11.1% (1)
3 (15.4%, 8)	Knife, pipe, brass knuckles	12.5% (1)
	Knife, pipe, stick	12.5% (1)
	Knife, pipe, other	12.5% (1)
	Knife, pipe, martial arts weapon	12.5% (1)
	Knife, martial arts weapon, other	12.5% (1)
	Knife, gun, brass knuckles	12.5% (1)
	Knife, gun, pepper spray	12.5% (1)
	Gun, pipe, other	12.5% (1)
4 (1.9%, 1)	Knife, pipe, stick, other	100% (1)
5 (3.8%, 2)	Knife, pipe, stick, martial arts weapon, other	100% (2)

Note.

- a Knife may include straight razor or switchblade.
- b Pipe may include club or bat.
- c Pepper spray may include Mace.

3 months. The reported main reasons for carrying a weapon were protection (66%), holding it for a friend (3.8%), criminal use (3.8%), and other unspecified purposes (26.4%). The mean number of weapons carried was 1.69 (SD=1.06), and the mean number of places that weapons were carried was 2.06 (SD=1.38). Table 1 presents descriptive information regarding the types/combinations of weapons carried. Table 2 describes the types/combinations of places that weapons were carried.

Predictors of Weapon Carrying

Table 3 provides descriptive statistics for weapon carrying during the past 3 months as well as for the independent variables in the replication and expanded

models. Nagelkerke R square was used to estimate explained variance for the models and the Hosmer-Lemeshow test was used to determine goodness of fit.

Replication model. Age, gender, and race/ethnicity were entered into block 1, which significantly accounted for 11% of the variance in 3-month weapon carrying, $\chi^2(5, N=308)=21.23, P<.01$. Male gender (OR=1.99, 1.03-3.86), being black (OR=.09, .02-.44), and being Hispanic (OR=.33, .14-.75) were significant variables in block 1.

Block 2 included the parental monitoring variable. After entry of block 2, the model significantly explained 16% of the variance, $\chi^2(6, N=308)=31.33, P<.001$. Male gender (OR=1.96, 1.00-3.84), being black (OR=.10, .02-.48), being Hispanic (OR=.37,

Table 2
Places Where Weapons Were Carried During the Past 3 Months
(n=53)

Number of Places (% , n)	Types/Combinations of Places Carried	% (n)
1 (54.9%, 28)	Neighborhood	53.6% (15)
	School	3.6% (1)
	Other	42.9% (12)
2 (11.8%, 6)	Neighborhood, other	83.3% (5)
	Business, other	16.7% (1)
3 (13.7%, 7)	Friend's home, neighborhood, other	71.4% (5)
	Neighborhood, school, other	14.3% (1)
	Business, school, other	14.3% (1)
4 (11.8%, 6)	Business, friend's home, neighborhood, other	50% (3)
	Friend's home, school, neighborhood, other	50% (3)
5 (7.8%, 4)	Business, friend's home, neighborhood, school, other	100% (4)

.16-.86), and parental monitoring (OR=.48, .30-.76) were significant in block 2.

Block 3 added peer pressure for substance use, peer weapon carrying/jail time, school status, school suspensions, and exercise. The full model significantly explained 39% of the variance in 3-month weapon carrying, $\chi^2(11, N=308)=81.98$, $P<.001$ and met goodness-of-fit standards, $\chi^2(8, N=308)=7.40$, $P=.49$.

Summary statistics for the full replication model are presented in Table 4. The significant variables in the full model were male gender, being black, being Hispanic, peer modeling of weapon carrying/jail time, and school suspensions.

Expanded model. Age, gender, race/ethnicity, and sexual orientation were entered into block 1, which significantly accounted for 14% of the variance in 3-month weapon carrying, $\chi^2(6, N=308)=27.00$, $P<.001$. Male gender (OR=2.12, 1.09-4.15), being black (OR=.07, .01-.35), being Hispanic (OR=.24, .10-.58), and heterosexual sexual orientation (OR=2.32, 1.14-4.74) were significant variables in block 1.

Block 2 again included the parental monitoring variable. After entry of block 2, the model significantly explained 18% of the variance, $\chi^2(7, N=308)=35.26$, $P<.001$. Male gender (OR=2.07, 1.04-4.09), being black (OR=.08, .02-.39), being Hispanic (OR=.29, .12-.71), and parental monitoring

(OR=.51, .32-.81) were significant in block 2; sexual orientation was near significant (OR=2.03, .99-4.17).

Block 3 added peer pressure for substance use, peer weapon carrying/jail time, school status, school suspensions, exercise, substance use, physical fighting, perception of neighborhood crime/gangs, employment, recruitment site, current homelessness, history of being kicked out of place of residence, and indices of neighborhood property and violent crime rates. The full model significantly explained 53% of the variance in 3-month weapon carrying, $\chi^2(21, N=308)=117.19$, $P<.001$ and met goodness-of-fit standards, $\chi^2(8, N=308)=8.40$, $P=.40$.

Summary statistics for the full expanded model are presented in Table 5. The significant variables in the full model were being black, being Hispanic, peer modeling of weapon carrying/jail time, school suspensions, physical fighting, and employment.

Comparability of Consistent Cohort

Tests for differences were conducted between the consistent cohort (n=308) and the remainder of the sample on all the variables in the expanded model. Three significant differences were found. Significantly fewer participants in the consistent cohort carried weapons (17.2% vs

Table 3
Weapon Carrying and Its Potential Determinants During the Past 3 Months (n=308)

Variables	%	Mean	SD	Range
Primary Outcome Variable				
Carried a weapon	17.20	—	—	—
Independent Variables				
Age	—	17.17	2.29	14.01-24.45
Gender (male)	59.40	—	—	—
Race/Ethnicity				
White	20.10	—	—	—
Black	13.30	—	—	—
Hispanic	54.20	—	—	—
Heterosexual				
Parental monitoring	—	2.26	0.68	1-3
Peer pressure for substance use	20.10	—	—	—
Peer modeling weapon/jail	—	0.57	0.76	0-2
School status (attending)	75.60	—	—	—
School suspensions	51.60	—	—	—
Vigorous exercise	—	2.22	2.20	0-7
Substance use	—	1.47	1.36	0-5
Involvement in physical fights	30.80	—	—	—
Neighborhood crime perception	—	3.06	1.23	2-6
Employment	38.60	—	—	—
Violent crime rate	—	5.58	1.28	.10-14.90
Property crime rate	—	35.76	7.11	6.70-84.50
Center location (urban)	72.70	—	—	—
Kicked out of home	19.50	—	—	—
Homeless	11.40	—	—	—

28.0%), $\chi^2(1, N=383)=4.51, P<.05$, were currently homeless (11.4% vs 35.1%), $\chi^2(1, N=385)=25.61, P<.001$, and had a history

of being kicked out of their place of residence (19.5% vs 38.7%), $\chi^2(1, N=383)=12.45, P<.001$.

Table 4
Full Replication Model: Determinants of Weapon Carrying During the Past 3 months (n=308)

Determinant	Wald	P	Adjusted OR	95% Confidence Intervals
Age	0.688	0.407	0.922	0.761 – 1.117
Gender (male)	5.873	0.015	2.684	1.208 – 5.965
White	1.156	0.282	0.547	0.183 – 1.642
Black	6.741	0.009	0.102	0.018 – 0.571
Hispanic	4.727	0.030	0.329	0.121 – 0.896
Parental monitoring	3.022	0.082	0.617	0.358 – 1.063
Peer pressure for substance use	0.036	0.849	1.086	0.462 – 2.554
Peer modeling weapon/jail	19.907	0.000	3.028	1.861 – 4.925
School status (attending)	1.997	0.158	0.511	0.202 – 1.296
School suspensions	9.481	0.002	3.750	1.617 – 8.697
Vigorous exercise	0.144	0.705	1.034	0.870 – 1.229
Constant	0.012	0.913	0.797	

Table 5
Full Expanded Model: Determinants of Weapon Carrying During
the Past 3 months (n=308)

Determinant	Wald	P	Adjusted OR	95% Confidence Intervals
Age	1.779	0.182	0.850	0.670 – 1.079
Gender (male)	3.000	0.083	2.213	0.901 – 5.437
White	0.308	0.579	0.686	0.182 – 2.593
Black	6.618	0.010	0.084	0.013 – 0.554
Hispanic	5.764	0.016	0.208	0.058 – 0.750
Heterosexual	1.193	0.275	1.701	0.656 – 4.410
Parental monitoring	0.939	0.332	0.724	0.377 – 1.391
Peer pressure for substance use	0.601	0.438	1.469	0.556 – 3.884
Peer modeling weapon/jail	7.183	0.007	2.216	1.238 – 3.965
School status (attending)	1.103	0.294	0.558	0.188 – 1.658
School suspensions	6.346	0.012	3.652	1.333 – 10.003
Vigorous exercise	0.097	0.755	1.033	0.844 – 1.263
Substance use	2.085	0.149	1.304	0.910 – 1.868
Involvement in physical fights	9.137	0.003	3.809	1.600 – 9.066
Neighborhood crime perception	2.238	0.135	1.303	0.921 – 1.841
Employment	14.160	0.000	5.823	2.326 – 14.577
Violent crime rate	0.064	0.800	0.939	0.580 – 1.522
Property crime rate	0.765	0.382	1.044	0.948 – 1.148
Center location (urban)	0.469	0.493	0.671	0.214 – 2.103
Homeless	0.276	0.600	0.693	0.176 – 2.726
Kicked out of home	0.408	0.523	1.410	0.491 – 4.048
Constant	0.947	0.330	0.065	

DISCUSSION

The purpose of this study was to test and compare 2 predictive models of weapon carrying in youth attending drop-in centers in San Diego and Imperial counties. Both the replication and expanded models were based on the BEM, used the same conceptual 3-block sequence, were tested using sequential logistic regressions, met goodness-of-fit criteria, and explained significant amounts of variance in weapon carrying. The models differed in the potential predictors included in the demographic and peer/environmental domains.

This study was part of a larger investigation designed to evaluate drop-in centers. This limited the data available for examining potential predictors of weapon carrying, and our analyses thus represent a somewhat conservative test of theory-based predictors. Nonetheless, our results may help identify youth at greatest risk for weapon carrying and support further research on potential determinants of weapon carrying based on the

BEM or other learning theories.

The 17.2% rate of weapon carrying found in our sample is similar to the 18.0% rate for high school students nationally and higher than the 14.1% rate for high school students in San Diego, as reported in the most recent YRBS.²¹ Approximately two-thirds of the participants who reported carrying a weapon indicated that their main reason for doing so was protection. Close to two-thirds reported carrying 1 weapon, with knives, straight razors, or switchblades being the predominant weapons carried among those reporting carrying 1 weapon only.

It is difficult to compare these findings to other reports in the literature due to variations in measures across studies. A number of other studies⁴⁶⁻⁴⁹ have not separately assessed weapon carrying and the reason for carrying, instead asking only whether youth had carried a weapon for protection. Simon et al⁵⁰ reported that 76% of students in their study listed "for defense" as a reason for carrying a weapon to school; however, respondents were al-

lowed to endorse multiple reasons for carrying. McNabb et al⁵¹ asked about the single main reason for gun carrying, finding that 40% of adolescents reported self-defense as the reason.

The number of places that a weapon was carried during the past 3 months ranged from 1 to 5. Over half the participants who carried weapon(s) reported carrying it/them in only 1 place, with neighborhood being the predominant place of weapon carrying among those participants who reported carrying weapon(s) in 1 location only.

The replication model tested required 2 adjustments to the model used in our previous work predicting substance use:³⁶ (1) conducting a sequential logistic regression analysis rather than a sequential multiple regression, due to the extreme skew of the dependent variable; and (2) using an individual item to assess school suspensions rather than a scale representing suspensions and expulsions, due to an unacceptable Cronbach's alpha level. The result of our exploration of the generalizability of the replication model was quite successful: the full replication model for weapon carrying significantly explained slightly more variance than the full model for substance use³⁶ (39% and 36%, respectively).

In block 1 of the replication model, male gender, being black, and being Hispanic emerged as significant variables, and all 3 of these variables remained significant after the addition of both block 2 and block 3. Parental monitoring, the only variable included in block 2, was significant when entered in block 2, but moved to near significance in block 3. Previous studies of the association between parental monitoring and weapon carrying have been mixed; some have found that parental monitoring^{35,52} or maternal monitoring⁵³ decreased the odds of youth carrying a weapon, whereas a recent study of students in Botswana⁵⁴ found monitoring by parents had no effect on weapon carrying.

In the full replication model, significant predictors of weapon carrying were male gender, being black, being Hispanic, peer modeling of weapon carrying/jail time, and school suspensions. The protective OR for being black was the strongest in the replication model, but we suspect some deflation of that OR due to the small number of black participants in our sample.

Though male gender predicting weapon

carrying is a near-universal finding in published research, the literature is less conclusive about race/ethnicity. Some studies found black or other minority ethnicity^{30,55} or black race⁵⁶ predictive of weapon carrying; others found race was not a significant predictor,^{7,10,57} and another found black and Hispanic adolescents less likely than whites to carry a handgun.⁵³ The latest YRBS found the influence of race/ethnicity to vary by gender: "The prevalence of having carried a weapon was higher among black female (10.0%) and Hispanic female (9.0%) than white female (6.1%) students; and higher among white male (30.3%) than black male (24.6%) students."²¹

The strongest significant risk factor for weapon carrying in the full replication model was school suspensions, followed by peer modeling of weapon/jail time. Each of those factors had an OR greater than 3 for weapon carrying in the past 3 months. We were unable to find other studies that have reported findings similar to our results regarding school suspensions. The only study we found that assessed both weapon carrying and school suspensions made no attempt to link the two.⁵⁸ The appearance of peer modeling as one of the strongest predictors of weapon carrying in the model is consistent with BEM and is an obviously face valid finding.

It is important to acknowledge that we did not assess reasons for school suspensions, and weapon carrying may have been included among the reasons for suspension. Nonetheless, our findings suggest that school problems may have a greater influence on weapon carrying than peer modeling of weapon carrying (acknowledging that our peer-modeling-for-weapon-carrying scale also includes jail time). This indicates that interventions focusing on reinforcement and modeling of success in school might indirectly reduce risk behaviors such as weapon carrying.

The expanded model added 10 variables to the replication model, 1 in block 1 and 9 in block 3. Consistent with the block 1 results of the replication model, male gender, being black, and being Hispanic emerged as significant predictors, as did the added sexual orientation variable. The addition of heterosexual sexual orientation in block 1 increased the significantly explained variance in the demographics block by 3%. Sexual orientation was near significant in the expanded

model in block 2, but did not surface as a significant predictor of weapon carrying in the full model. Surprisingly, we were not able to find other studies that examined sexual orientation as a potential predictor of weapon carrying.

Consistent with the replication model, parental monitoring was the only variable included in block 2 in the expanded model and it was significant in block 2. Contrary to the replication model, parental monitoring moved from near significant to not significant in block 3 of the expanded model. The inclusion of additional variables in block 3 of the expanded model thus reduced the influence of parental monitoring on weapon carrying, which was still operating to some degree in the full replication model. After entry of block 2, the expanded model significantly explained 2% more variance in weapon carrying than the replication model did at the same point (18% vs 16%, respectively).

The addition of block 3 to the expanded model added 35% to significantly explained variance in weapon carrying compared to the 23% increase from blocks 2 to 3 in the replication model. Thus, the addition of the 9 variables to block 3 of the expanded model resulted in block 3 accounting for 12% more variance in 3-month weapon carrying than did block 3 of the replication model. Compared to the full replication model, the full expanded model significantly explained 14% more variance in weapon carrying (39% vs 53%, respectively).

Six significant predictors emerged in the full expanded model. Four of the same predictors from the full replication model remained significant (being black, being Hispanic, peer modeling of weapon carrying/jail time, and school suspensions), with male gender being near significant. It is interesting to note that the strong protective factors of being black and being Hispanic remained significant in the full expanded model in the context of 10 additional variables in the model.

Our findings related to being black or Hispanic in both models prompted us to explore gender by ethnicity interactions in weapon carrying. The results of this exploration suggest that our findings for blacks may be unreliable due to an insufficient number of blacks in our sample. The rates of weapon carrying for both black males (3.8%) and females (.0%) were very low. Thus, being black may indeed be

protective for weapon carrying, but this result should be tested in future research.

The rate of weapon carrying for Hispanic females in our sample was 5.7% in contrast to 35.8% for Hispanic males. Thus, our protective finding for being Hispanic is being driven entirely by Hispanic females, which disallows making conclusions about being Hispanic overall. Being a Hispanic female is protective for weapon carrying whereas being a Hispanic male is a risk factor.

The new significant predictors emerging in the full expanded model were physical fighting and employment. Many studies have reported an association between fighting and weapon carrying,^{9,58-61} and thus, its significance is not surprising. Because of the association between male gender and physical fighting, fighting may account for some of the variance in the expanded model that gender accounted for in the replication model and thus explain the reduced role of gender in the expanded model.

We are frankly puzzled by the finding related to employment. It surfaced as by far the strongest risk factor for weapon carrying in the past 3 months in the full expanded model. We acknowledge that our Y/N question "Do you work to earn money for yourself?" is not comparable to measures such as household income or socioeconomic status, which have been negatively related to weapon carrying in other studies.^{30,62} We suspect that there may be a yet-to-be-determined mediator variable operating in the relationship between employment and weapon carrying that future studies may be able to uncover.

The fact that none of the other variables added to block 3 of the expanded model emerged as significant predictors is surprising, given the importance of environmental/ecological influences posited by the BEM. Although we expected the full expanded model to significantly explain more variance in weapon carrying than the full replication model, we did not anticipate that the fairly impressive gain in explained variance would be due primarily to variables representing fighting and "working to earn money for yourself."

The youth using the drop-in centers were very heterogeneous, and our participants were not a probability sample of attendees. Moreover, the consistent cohort had significantly lower risks than the remainder of our sample on carrying

weapons, currently homeless, and "kicked out." Thus, our findings may have limited generalizability to drop-in center youth as a whole. Also, although the models tested posited temporal ordering of variables based on theory, the present analyses are based on cross-sectional data. Nonetheless, our results should help inform future in-depth and longitudinal investigations of determinants of weapon carrying based on theory, as well as help guide identification of youth at greatest risk of weapon carrying for prevention intervention efforts.

Summary and Directions for Future Research

Overall, our results from this study generated findings of interest on several fronts. Our generalizability test of the replication model demonstrated that the same BEM-based model previously used to significantly predict substance use³⁶ worked equally well to predict weapon carrying. The testing and comparison of the replication and expanded models of weapon carrying examined in this study yielded both some expected and unexpected results.

Both full models shared the significant protective factors of being black and being Hispanic and the risk factors of peer modeling of weapon carrying/jail time and school suspensions. The full expanded model added the significant risk factors of physical fighting and having employment. As discussed, the emergence of peer modeling of weapon carrying/jail time and physical fighting as risk factors is not surprising and is supported by the literature and/or theory.

The other 4 variables that emerged as significant predictors involve unexpected results, limitations in our data, and/or limitations in the literature that may serve as guides for some important areas of future recommended research. Although being black surfaced as a strong protective factor of weapon carrying in both models tested, as discussed, the small number of black participants in our sample requires that this finding be tested in future studies. Similarly, our protective finding of being a Hispanic female (vs the risk factor found for being a Hispanic male) should also be further explored by additional research.

As we were unable to find other studies that have reported findings similar to

ours regarding school suspensions, future studies should further examine school suspensions as a potential risk factor for weapon carrying in the context of fully exploring and controlling for weapon carrying as a reason for suspension from school. Lastly, our surprising findings related to employment as a risk factor warrant replication and further investigation to reveal potential mediator variables in the relationship between employment and weapon carrying.

Acknowledgments

This research was supported by grants from the California HIV/AIDS Research Program, University of California (#PE00-SDSU-153, #IS99-SDSUF-206, and #IS02-CBECH-711) and the National Institutes of Health/National Heart, Blood, and Lung Institute (#5R01HL068595-05) and by intramural support from The Center for Behavioral Epidemiology and Community Health. The authors thank Patricia Hodge, MPH, for her contributions to this study. ■

REFERENCES

1. DuRant RH, Getts AG, Cadenhead C, et al. The association between weapon carrying and the use of violence among adolescents living in and around public housing. *J Adolesc Health*. 1995;17(6):376-380.
2. Lowry R, Powell KE, Kann L, et al. Weapon-carrying, physical fighting, and fight-related injury among U.S. adolescents. *Am J Prev Med*. 1998;14(2):122-129.
3. Malek MK, Chang BH, Davis TC. Fighting and weapon-carrying among seventh-grade students in Massachusetts and Louisiana. *J Adolesc Health*. 1998;23(2):94-102.
4. Andershed H, Kerr M, Stattin H. Bullying in school and violence on the streets: are the same people involved? *Journal of Scandinavian Studies in Criminology and Crime Prevention*. 2001;2(1):31-49.
5. Fitzpatrick KM. Aggression and environmental risk among low-income African-American youth. *J Adolesc Health*. 1997;21(3):172-178.
6. Malek MK, Chang BH, Davis TC. Self-reported characterization of seventh-grade students' fights. *J Adolesc Health*. 1998;23(2):103-109.
7. Kingery PM, Coggeshall MB, Alford AA. Violence at school: recent evidence from four national surveys. *Psychology in the Schools*. 1998;35(3):247-258.
8. Resnick MD, Ireland M, Borowsky I. Youth violence perpetration: what protects? What predicts? Findings from the National Longitudinal Study of Adolescent Health. *J Adolesc Health*. 2004;35(5):424.e1-e10.
9. Pickett W, Craig W, Harel Y, et al. Cross-

- national study of fighting and weapon carrying as determinants of adolescent injury. *Pediatrics*. 2005;116(6):e855-e863.
10. Kulig J, Valentine J, Griffith J, et al. Predictive model of weapon carrying among urban high school students: results and validation. *J Adolesc Health*. 1998;22(4):312-319.
 11. Myers GP, McGrady GA, Marrow C, et al. Weapon carrying among black adolescents: a social network perspective. *Am J Public Health*. 1997;87(6):1038-1040.
 12. Bailey SL, Flewelling RL, Rosenbaum DP. Characteristics of students who bring weapons to school. *J Adolesc Health*. 1997;20(4):261-270.
 13. Webster DW, Gainer PS, Champion HR. Weapon carrying among inner-city junior high school students: defensive behavior vs aggressive delinquency. *Am J Public Health*. 1993;83(11):1604-1608.
 14. Black MM, Ricardo IB. Drug use, drug trafficking, and weapon carrying among low-income, African-American, early adolescent boys. *Pediatrics*. 1994;93(6, pt 2):1065-1072.
 15. Centers for Disease Control and Prevention. Weapon carrying among high school students—United States, 1990. *MMWR Morb Mortal Wkly Rep*. 1991;40(40):681-684.
 16. Centers for Disease Control and Prevention. Health-risk behaviors among persons aged 12-21 years—United States, 1992. *MMWR Morb Mortal Wkly Rep*. 1994;43:231-235.
 17. Kann L, Warren W, Collins JL, et al. Results from the national school-based 1991 Youth Risk Behavior Survey and progress toward achieving related health objectives for the nation. *Public Health Rep*. 1993;108(Suppl 1):47-67.
 18. Smith-Khuri E, Iachan R, Scheidt PC, et al. A cross-national study of violence-related behaviors in adolescents. *Arch Pediatr Adolesc Med*. 2004;158(6):539-544.
 19. Zhang L, Johnson WD. Violence-related behaviors on school property among Mississippi Public High School students, 1993-2003. *J Sch Health*. 2005;75(2):67-71.
 20. Brener N, Lowry R, Barrios L, et al. Violence-related behaviors among high school students - United States, 1991-2003 - Centers for Disease Control and Prevention. *J Sch Health*. 2005;75(3):81-85.
 21. Centers for Disease Control and Prevention. Youth Risk Behavior Surveillance - United States, 2007. Surveillance Summaries. *MMWR Morb Mortal Wkly Rep*. 2008;57(SS-04). Available at: http://www.cdc.gov/HealthyYouth/yrbs/pdf/yrbss07_mmwr.pdf. Accessed July 18, 2008.
 22. U.S. Department of Health and Human Services. *Healthy People 2010*. 2nd ed. With Understanding and Improving Health and Objectives for Improving Health. 2 vols Washington, DC: U.S. Government Printing Office, 2000. Available at: <http://www.healthypeople.gov/document/html/objectives/15-39.htm>. Accessed May 17, 2007.
 23. Kodjo CM, Auinger P, Ryan SA. Demographic, intrinsic, and extrinsic factors associated with weapon carrying at school. *Arch Pediatr Adolesc Med*. 2003;157(1):96-103.
 24. Lloyd JJ, Delva J, Arria AM. Recent weapon carrying and substance use among United States Virgin Islands youth. *Subst Use Misuse*. 2000;35(9):1207-1225.
 25. McKeganey N, Norrie J. Association between illegal drugs and weapon carrying in young people in Scotland: schools' survey. *BMJ*. 2000;320(7240):982-984.
 26. Atav S, Spencer GA. Health risk behaviors among adolescents attending rural, suburban, and urban schools: a comparative study. *Fam Community Health*. 2002;25(2):53-64.
 27. Rountree PW. Weapons at school: are the predictors generalizable across context? *Sociological Spectrum*. 2000;20(3):291-324.
 28. Simon TR, Dent CW, Sussman S. Vulnerability to victimization, concurrent problem behaviors, and peer influence as predictors of in-school weapon carrying among high school students. *Violence Vict*. 1997;12(3):277-289.
 29. DuRant RH, Getts AG, Cadenhead C, et al. The association between weapon-carrying and the use of violence among adolescents living in or around public-housing. *J Adolesc*. 1995;18(5):579-592.
 30. Forrest KYZ, Zychowski AK, Stuhldreher WL, et al. Weapon-carrying in school: prevalence and association with other violent behaviors. *American Journal of Health Studies*. 2000;16(3):133-140.
 31. Molnar BE, Miller MJ, Azrael D, et al. Neighborhood predictors of concealed firearm carrying among children and adolescents: results from the project on human development in Chicago neighborhoods. *Arch Pediatr Adolesc Med*. 2004;158(7):657-664.
 32. Kuntsche EN, Klingemann HK. Weapon-carrying at Swiss schools? A gender-specific typology in context of victim and offender related violence. *J Adolesc*. 2004;27(4):381-393.
 33. Linville DC, Huebner AJ. The analysis of extracurricular activities and their relationship to youth violence. *J Youth Adolesc*. 2005;34(5):483-492.
 34. Malecki CK, Demaray MK. Carrying a weapon to school and perceptions of social support in an urban middle school. *J Emot Behav Disord*. 2003;11(3):169-178.
 35. Orpinas P, Murray N, Kelder S. Parental influences on students' aggressive behaviors and weapon carrying. *Health Educ Behav*. 1999;26(6):774-787.
 36. Bousman CA, Blumberg EJ, Shillington AM, et al. Predictors of substance use among homeless youth in San Diego. *Addict Behav*. 2005;30(6):1100-1110.
 37. Hovell MF, Wahlgren DR, Gehrman CA. The behavioral ecological model: integrating public health and behavioral science. In: DiClemente

- RJ, Crosby R, Kegler M, eds. *New and Emerging Models and Theories in Health Promotion and Health Education*. San Francisco, CA: Jossey-Bass Inc, 2002:347-385.
38. Hovell MF, Wahlgren DR, Adams M. The logical and empirical basis for the behavioral ecological model. In RJ DiClemente, RA Crosby, M Kegler (Eds). *Emerging Theories and Models in Health Promotion Research and Practice: Strategies for Enhancing Public Health*; 2nd edition. San Francisco: Jossey-Bass, Inc. In Press.
 39. Song YJ, Hofstetter CR, Hovell MF, et al. Acculturation and health risk behavior among Californians of Korean descent. *Prev Med*. 2004;39:147-156.
 40. Hofstetter CR, Hovell MF, Lee J, et al. Tobacco use and acculturation among Californians of Korean descent: a behavioral epidemiological analysis. *Nicotine Tob Res*. 2004;6(3):481-489.
 41. Martinez-Donate AP, Hovell MF, Hofstetter CR, et al. Crossing borders: the impact of the California Tobacco Control Program on both sides of the US-Mexico Border. *Am J Public Health*. 2008;98(2):258-267.
 42. Adams MA, Hovell MF, Irvin V, et al. Promoting stair use by modeling: an experimental application of the Behavioral Ecological Model. *Am J Health Promot*. 2006;21(2):101-109.
 43. Turner CF, Ku L, Rogers SM, et al. Adolescent sexual behavior, drug use, and violence: increased reporting with computer survey technology. *Science*. 1998;280(5365):867-873.
 44. California Department of Justice. California and FBI Crime Indices for Years 2001-2003, Table 11 for Imperial, Los Angeles, Orange, Riverside, and San Diego Counties. 2007. Sacramento, California. Available at: <http://ag.ca.gov/cjsc/misc/mfirs.php>. Accessed June 20, 2007.
 45. California Department of Finance. E-4 Population Estimates for Cities, Counties and the State, 2001-2007, with 2000 Benchmark. 2007. Sacramento, California. Available at: <http://www.dof.ca.gov/HTML/DEMOGRAP/ReportsPapers/Estimates/E4/E4-01-06/HistE-4.asp>. Accessed June 20, 2007.
 46. Martin SL, Sadowski LS, Cotten NU, McCarragher DR. Response of African-American adolescents in North Carolina to gun carrying by school mates. *J Sch Health*. 1996;66(1):23-26.
 47. Webster DW, Gainer PS, Champion HR. Weapon carrying among inner-city junior high school students: defensive behavior vs aggressive delinquency. *Am J Public Health*. 1993;83(11):1604-1608.
 48. Cotten NU, Resnick J, Browne DC, et al. Aggression and fighting behavior among African-American adolescents: individual and family factors. *Am J Public Health*. 1994;84(4):618-622.
 49. Cao L, Zhang Y, He N. Carrying weapons to school for protection: an analysis of the 2001 school crime supplement data. *J Crim Justice*. 2008;36(2):154-164.
 50. Simon TR, Dent CW, Sussman S. Vulnerability to victimization, concurrent problem behaviors, and peer influence as predictors of in-school weapon carrying among high school students. *Violence Vict*. 1997;12(3):277-289.
 51. McNabb SJN, Farley TA, Powell KE. Correlates of gun-carrying among adolescents in south Louisiana. *Am J Prev Med*. 1996;12(2):96-102.
 52. Loeber R, Burke JD, Mutchka J, et al. Gun carrying and conduct disorder: a highly combustible combination? Implications for juvenile justice and mental and public health. *Arch Pediatr Adolesc Med*. 2004;158(2):138-145.
 53. Luster T, Oh SM. Correlates of male adolescents carrying handguns among their peers. *J Marriage Fam*. 2001;63(3):714-726.
 54. Malet L. Aggressive and antisocial behaviours among secondary school students in Botswana - The influence of family and school based factors. *Sch Psychol Int*. 2007;28(1):90-109.
 55. DuRant RH, Krowchuk DP, Kreiter S, et al. Weapon carrying on school property among middle school students. *Arch Pediatr Adolesc Med*. 1999;153(1):21-26.
 56. Hayes DN, Hemenway D. Age-within-school-class and adolescent gun-carrying. *Pediatrics*. 1999;103(5):e64.
 57. Grunbaum JA, Basen-Engquist K, Pandey D. Association between violent behaviors and substance use among Mexican-American and non-Hispanic white high school students. *J Adolesc Health*. 1998;23(3):153-159.
 58. Alikasifoglu M, Erginoz E, Ercan O, et al. Violent behaviour among Turkish high school students and correlates of physical fighting. *Eur J Public Health*. 2004;14(2):173-177.
 59. Aspy CB, Oman RF, Vesely SK, et al. Adolescent violence: the protective effects of youth assets. *J Couns Dev*. 2004;82(3):268-276.
 60. Laufer A, Harel Y. Correlation between school perception and pupil involvement in bullying, physical fights and weapon carrying. *Megamot*. 2003;42(3):437-459.
 61. Prinstein MJ, Boergers J, Spirito A. Adolescents' and their friends' health-risk behavior: factors that alter or add to peer influence. *J Pediatr Psychol*. 2001;26(5):287-298.
 62. Price JH, Everett SA. A national assessment of secondary school principals' perceptions of violence in schools. *Health Educ Behav*. 1997;24(2):218-229.